IS 4910-13 (1989): Methods of Test for Tyre Yarns, Cords and Tyre Cord Warpsheets made From Man-Made Fibres, Part 13: Static Adhesion of Textile Tyre Cord to Vulcanized Rubber [TXD 1: Physical Methods of Tests]

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IS 4910 (Part 13) : 1989
(Reaffirmed 2000)

Indian Standard

METHODS OF TEST FOR TYRE YARNS, CORDS AND TYRE CORD WARPSHEETS MADE FROM MAN-MADE FIBRES

PART 13 STATIC ADHESION OF TEXTILE TYRE CORD TO VULCANIZED RUBBER

भारतीय मानक

कृत्रिम रेशों से निर्मित सूत डोरी और टायर
डोरी ताना चद्दरों की परीक्षण की पद्धतियाँ

भाग 13 टैक्सटाइल टायर डोरी का वल्कनीकृत रबड़ से स्थैतिक आसंजन

UDC 677·072·6:629·11·012·553:1:677·017·424·25:678·43

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Price Group 7

FOREWORD

This Indian Standard (Part 13) was adopted by the Bureau of Indian Standards on 15 July 1989, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council.

The property of static adhesion of tyre cord to rubber is very important in order to ensure satisfactory bonding of rubber to the cord during the manufacture of tyres and other cord-reinforced products. Different methods are followed to determine the property by vulcanizing tyre cord with rubber and then pulling out the cord to measure the force required to do so. This standard deals with the methods based on practices prevalent in the country in this field.

This standard (Part 13) forms a part of a series of standards under the title 'Methods of test for tyre yarns, cords and tyre cord warpsheets made from man-made fibres'.

In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

METHODS OF TEST FOR TYRE YARNS, CORDS AND TYRE CORD WARPSHEETS MADE FROM MAN-MADE FIBRES

PART 13 STATIC ADHESION OF TEXTILE TYRE CORD TO VULCANIZED RUBBER

1 SCOPE

1.1 This standard (Part 13) prescribes four methods for determination of static adhesion of dipped cords to rubber, namely, H-Test, T-Test, U-Test and strip adhesion test.

1.2 The property levels obtained with these methods are affected considerably by the history of the cord and the rubber compound. However, they yield data on which the judgement may be based for the service quality of the material.

2 REFERENCES

2.1 The following Indian Standard is a necessary adjunct to this standard:

IS No.	*Title*
IS 1745 : 1978	Petroleum hydrocarbon solvents (*second revision*)

3 SAMPLING

3.1 Sample from the lot shall be drawn so as to be representative of the lot. Sample drawn in accordance with the relevant material specification or as agreed to between the buyer and the seller shall be held to be representative of the lot.

4 METHOD A : H-TEST

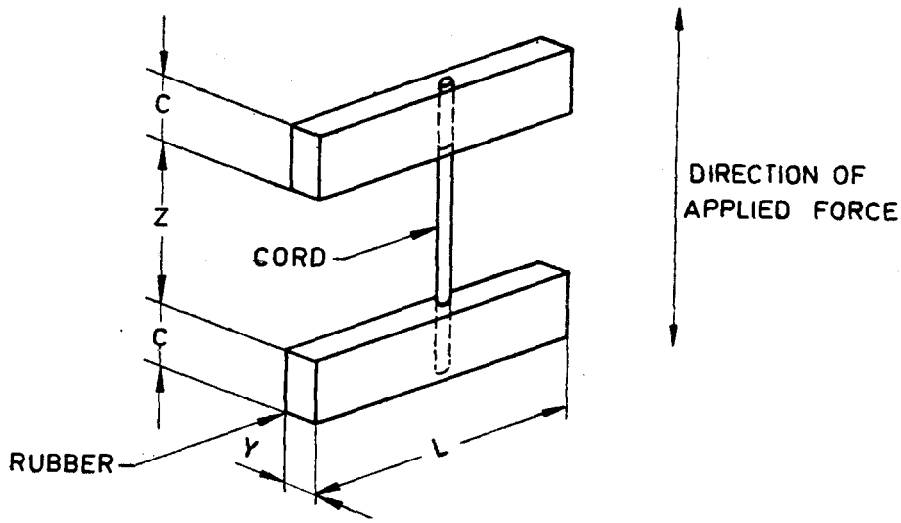
4.1 Principle

Assessment of the adhesion between a rubber and textile cord is made by measuring the force required to pull a single cord from a block of cured rubber, the force being applied along the longitudinal axis of the cord and the length of cord embedded in the rubber being fixed. The adhesion measured is essentially a shearing force acting at the cord-to-rubber interface. The two strips of rubber and the interconnecting cord form a test piece resembling the letter 'H' as shown in Fig. 1, from which the test derives its name.

4.2 Apparatus

4.2.1 *Suitable Mould*

The dimensions of test pieces are controlled by the specifications and tolerances of the mould. The test pieces are prepared by laying strips of rubber of thickness $y/2$ (*see* Fig. 1), spaced Z apart, into cavities in a mould of width C. Cords are stretched over and perpendicular to the rubber strips with a distance L between each cord. Two further strips of rubber are applied above the cord, the mould closed, put into a press, and the test pieces vulcanized. It is common practice to use moulds which allow many identical test pieces to be produced simultaneously.



All dimensions in millimetres.

FIG. 1 TEST PIECE FOR H-TEST

4.2.1.1 One example of a suitable mould is shown in Fig. 2. It is recommended that the width of the cord groove should be 0·8 mm for cords of linear density 560 tex or less, and 1·2 mm for cords of linear density greater than 560 and up to 800 tex. Although this form of mould is simple to use, the moulding pressure tends to force excess rubber down the cord groove between the rubber strips, particularly when the cord is much narrower than the groove. This 'flash' shall be removed from the cord by careful cutting before test to improve the reproducibility of results. The formation of this rubber flash can be almost completely eliminated by using a mould of the form shown in Fig. 3. The technique requires the cord length between the rubber strips to be held in position during cure by a deformable surface rather than a groove so that there are no voids into which excess rubber can flow. Two methods are shown in Fig. 3. In Method A, the cord between the rubber strips R_1 and R_2 and between R_3 and R_4 is held between specially prepared silicon rubber-faced bars. A suitable method for the preparation of such bars is described in Annex A. In Method B, the upper strip of rubber is made sufficiently wide to cover the whole distance R_5 to R_6 (and R_7 to R_8) with the addition of a thin cellophane polyester strip applied to the central portion of the rubber which contracts the cords to prevent the adherence of rubber to the cord in this region.

4.2.2 *Suitable Device to Provide a Tensioning Force of 0·49 ± 0·1 N*

This may be achieved, for example, by suspending a mass of 50 ± 1 g on one end of each cord during assembly of the test piece and removing it prior to placing the mould into the curing press. The masses may be of the hook type or designed in such a manner that they can be clamped to the cord. In any event, the total mass shall be 50 ± 1 g.

4.2.3 *Testing Machine*

It should be capable of accurately registering the applied forces during the test while maintaining the specified constant rate of separation of jaws at 300 ± 10 mm/minute and provided with a special stirrup for holding the test specimen (*see* Fig. 4).

NOTE — Inertia (pendulum) type dynamometers are apt to give results which differ because of frictional and inertial effects. A low inertia type of dynamometer with a suitable recorder gives results which are free from these effects and should, therefore, be preferred.

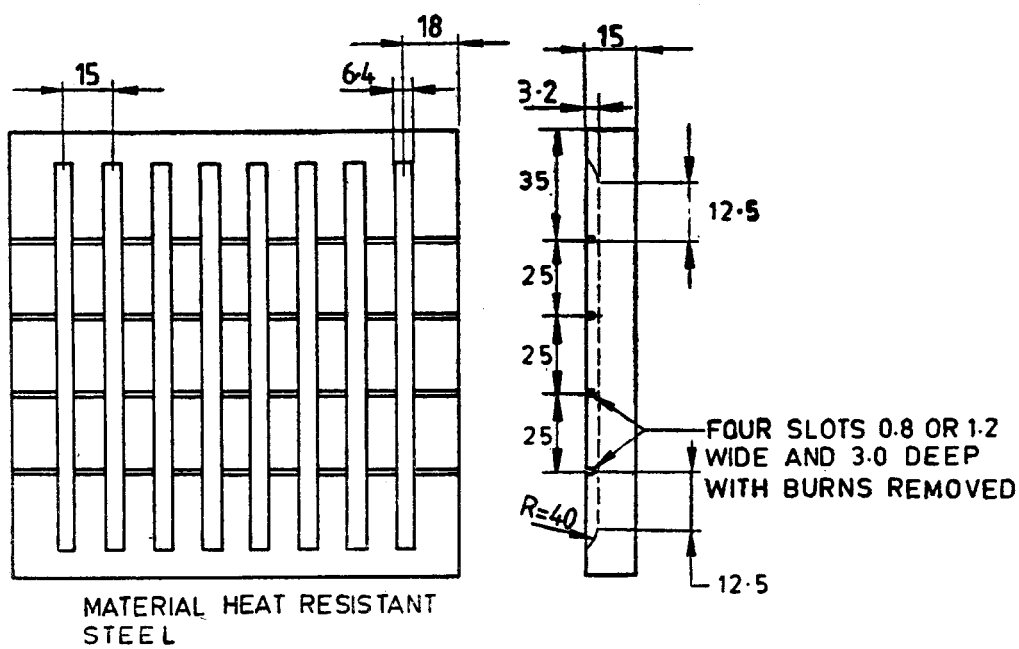
4.2.4 *Test Piece Grips*

The design of the test piece grips shall be as shown in Fig. 5A and 5B. Two such grips are required.

NOTE — The two types of grips do not necessarily give the same results.

4.3 Materials

4.3.1 The materials comprise any combination of rubber compound, textile cord and dip solution agreed upon by both the cord user and the supplier. The vulcanizing conditions, both time and temperature, shall be specified exactly. The thickness of the rubber compound required to fill the mould completely shall be determined by the supplier and the purchaser.



All dimensions in millimetres.

FIG. 2 SUITABLE MOULD FOR H-PULL TEST

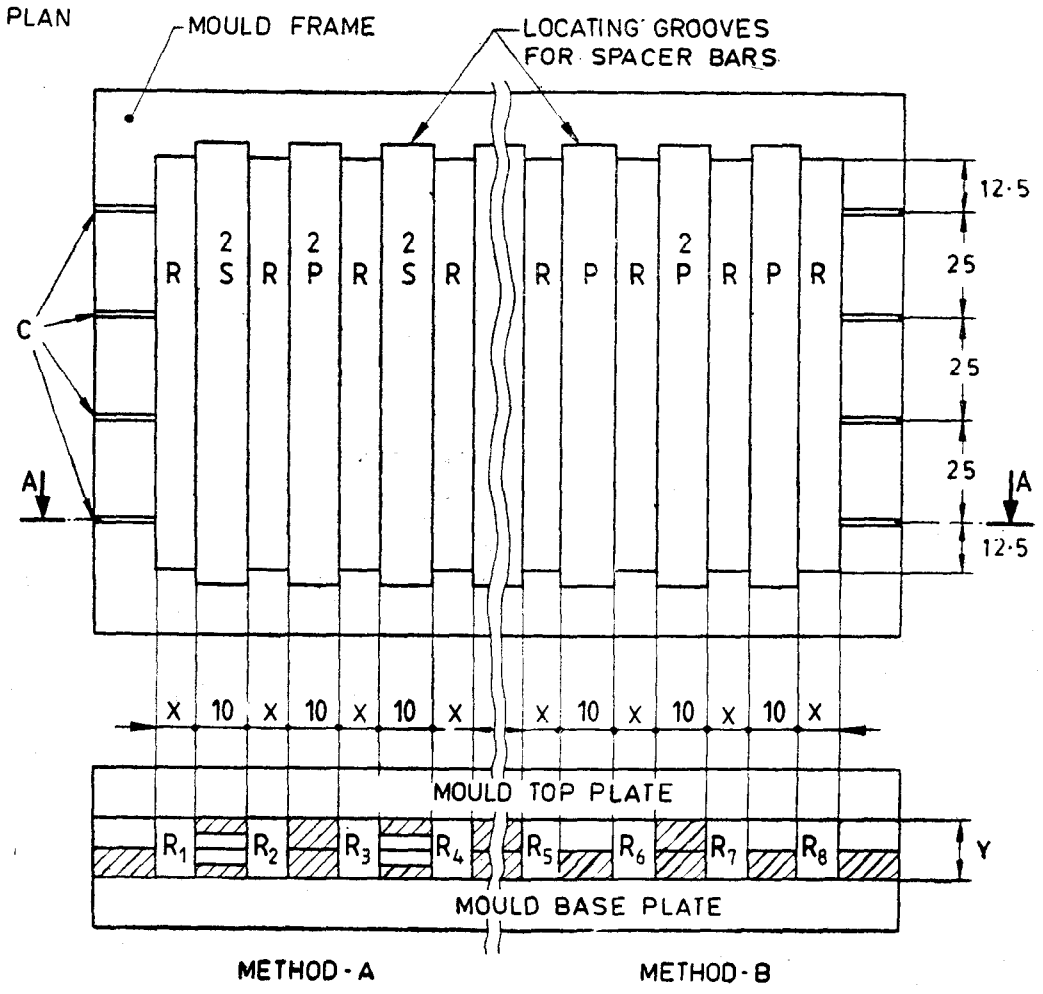
NOTES

1 The decision as to which rubber compound to use is normally made by the cord user.

2 Wherever possible, the unvulcanized rubber compound shall be freshly milled. If for any reason, the rubber cannot be remilled, the surface shall be freshened by wiping with heptane SBP spirit 55/115 conforming to IS 1745 : 1978. The compound shall be stored at room temperature prior to use. It may be in the form of calendered sheet of suitable thickness and should be protected by a dark coloured polyethylene film.

4.3.2 *Cotton Racking Fabric*

Square-woven, approximately 340 g/m² cotton fabric or its equivalent, shall be used to support the rubber strips. This may be grey fabric or fabric that has been frictioned on one side. Alternatively, the rubber compound may be calendered to the frictioned side of the cotton fabric. The rubber surface which will be in contact with the cords shall be protected by a protective film, such as starch paper or polyethylene.

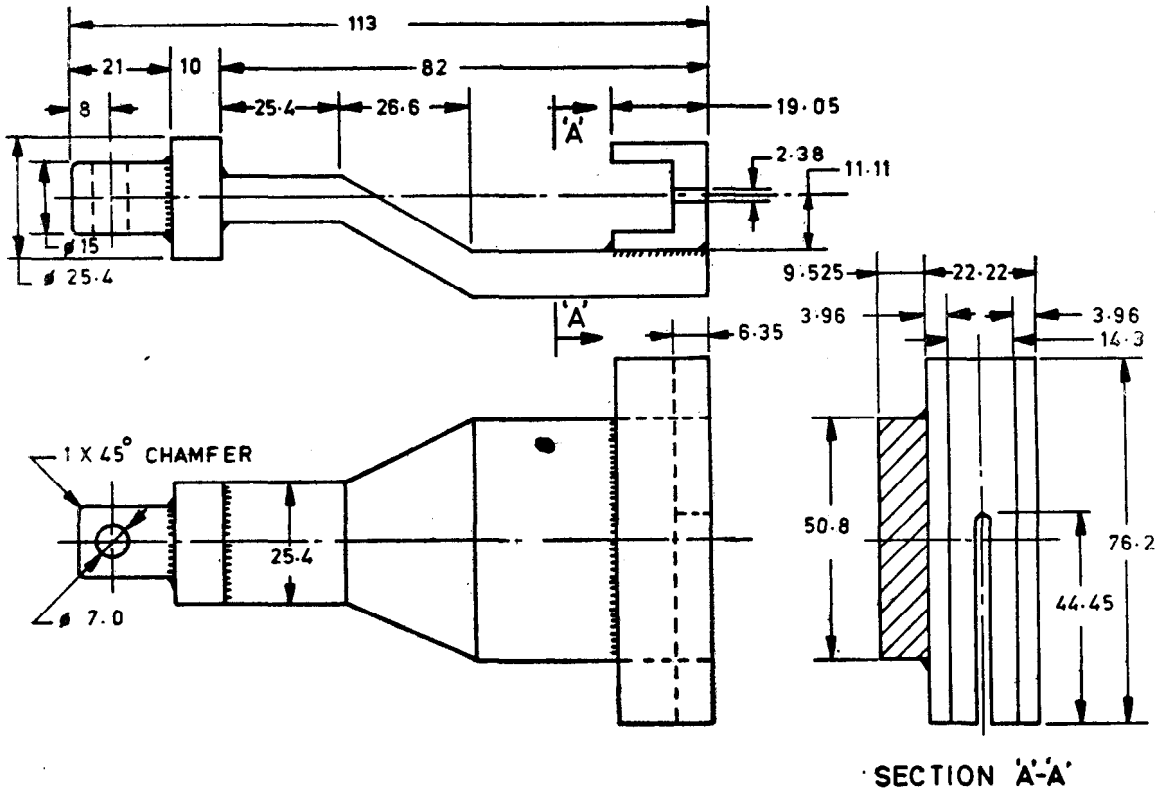


SECTION A-A

R = rubber cavity, width *X* and depth *Y*
S = silicon-rubber-faced bar
P = plain spacer bar
C = cord grooves, width 0·8 or 1·2

All dimensions in millimetres.

FIG. 3 METHODS OF PREPARATION OF TEST PIECES FOR H-TEST



All dimensions in millimetres.

FIG. 4 ADHESION TEST STIRRUP

4.4 Test Piece

4.4.1 *Dimensions*

The standard test piece shall be a length of cord embedded in rubber strips, nominally 6·4 mm wide and 3·2 mm thick (*see* **4.2.1**).

NOTE — Although this method specifies that the rubber strips shall be 3·2 mm thick, an inter laboratory test has equivalent values for 3·2 and 6·4 mm thick test pieces. The embedded length of cord may be reduced to 5 mm or increased to 10 mm where the adhesion is very high or very low, respectively but the results obtained using different embedded lengths are not comparable.

4.4.2 *Preparation of Test Pieces*

4.4.2.1 Cut the rubber compound into strips, 6 mm wide and of a suitable length leaving the protective film attached. This may be done with scissors or with a clicker die.

4.4.2.2 Cut strips of cotton fabrics to the same dimensions as those of the rubber compound. If the rubber compound is calendered on to the fabric, eliminate this step.

4.4.2.3 If necessary, place the bottom spacer bars in the mould of type shown in Fig. 3.

4.4.2.4 Using the mould at room temperature, place the fabric strips in the bottom of the mould cavities (*see* **4.4.2.2**).

4.4.2.5 Place the rubber strips in the mould cavities with the protective film side on top. If the rubber is calendered on to the fabric, the fabric side shall be on the bottom.

4.4.2.6 Remove the protective film from the rubber strips and immediately place the cords in the cord slots. The portion of the cord to be embedded in the rubber shall not be touched by bare hand. The procedure for handling calendered cords shall be agreed upon by the purchaser and the supplier. Knot each cord at one end so that it is secured firmly against the cord slot on one side of the mould. Take care to prevent the loss of the cord twist. Attach a tensioning device on the other end of the cord.

4.4.2.7 If required, place the upper spacer bars in the mould.

4.4.2.8 Remove the protective film from additional strips of rubber and place them in mould cavities on top of the cords. The side from which the protective film was removed shall be down. When preparing test pieces by Method B, these additional strips of rubber shall be 22 mm wide, with a strip of protective film or similar material replaced over the central 10 mm wide area.

4.4.2.9 Place strips of fabrics on top of the rubber strips. If the rubber is calendered on to the fabric, eliminate this step.

4.4.2.10 Identify the test piece in the mould and cover the mould with a smooth metal plate if the upper press plate is not smooth.

4.4.2.11 Remove the tensioning devices from the cords and place the moulds in a press which has been preheated to the vulcanizing temperature. Adjust the pressure to a minimum of 3·5 MPa with reference to the mould surface. After vulcanizing for specified time, immediately remove the test pad from the mould and cool at room temperature.

NOTE — A preheated mould may be used, but this will alter the vulcanizing conditions (time and temperature) of the rubber. If a preheated mould is used, the materials should exhibit sufficient green tackiness to permit the pad to be prefabricated in a cold mould and then transferred to the preheated mould.

4.4.2.12 Cut the pad using scissors, a sharp knife, or clicker die to produce 'H' pieces consisting of a single cord with each end embedded in the centre of a rubber tap approximately 25 mm in length. If necessary, trim off all excess rubber flash. When using Method B, the trimming should be carried out with great care to avoid cutting into the test piece.

4.4.3 *Number of Test Pieces*

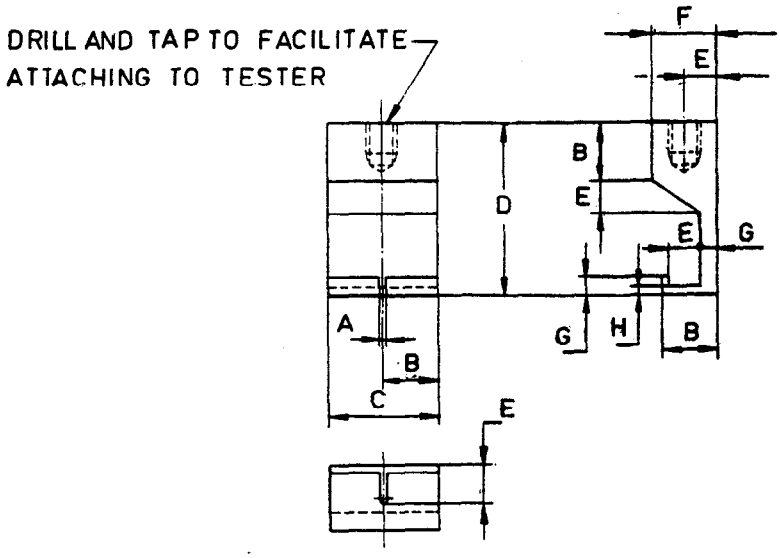
At least 8 test pieces shall be used.

4.4.4 *Time Interval Between Vulcanizing and Testing*

Unless otherwise specified for technical reasons, the minimum time between vulcanization and testing shall be 16 hours. The maximum time between vulcanization and testing shall be four weeks and for evaluations intended to be comparable, the test shall, as far as possible, be carried out after the same time interval.

4.5 Procedure

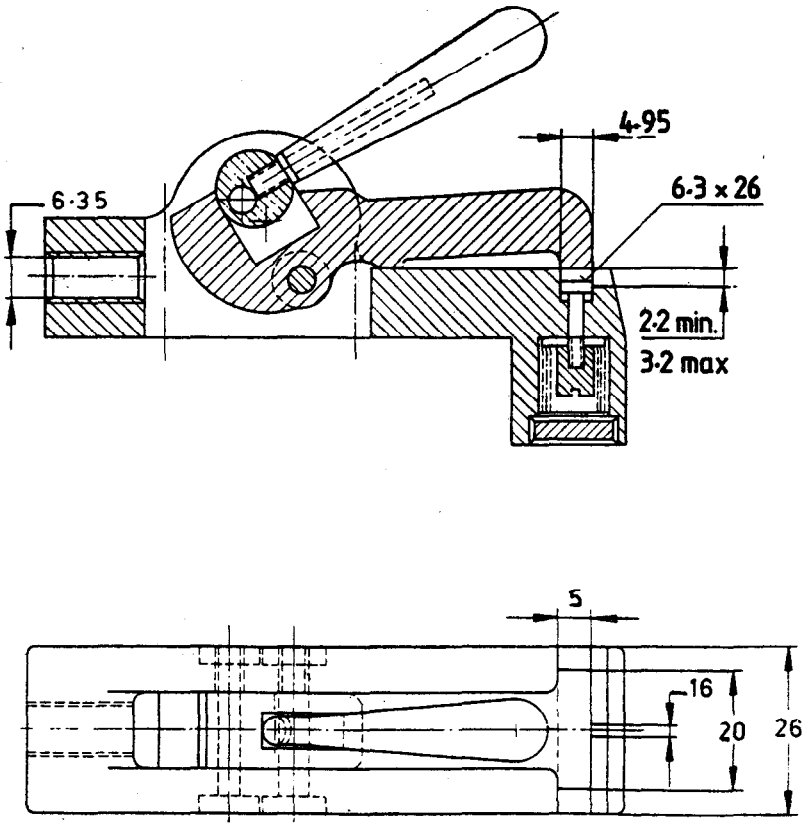
4.5.1 The force required to separate the cord from the rubber may be determined at room temperature or at an elevated temperature.



Dimension	mm
A	1·6
B	12·5
C	25·0
D	40·0
E	7·0
F	14·0
G	4·0
H	2·0

5A

FIG. 5 TEST PIECE GRIPS — *Contd*



5B

All dimensions in millimetres.

FIG. 5 TEST PIECE GRIPS

4.5.1.1 *Testing at room temperature*

Attach the test piece grips to the tension tester and set them 1 mm apart, take care to ensure axial alignment. Adjust the speed of the movable grip to 300 ± 10 mm/minute. Insert the test piece in the grips and start the tester. Record to the nearest 1·0 N, the maximum force required to separate the cord from the rubber.

4.5.1.2 *Testing at elevated temperature*

Proceed as described in **4.5.1.1** but enclose the test piece grips in an oven attached to the tester. Heat the test pieces in the oven, controlled at the test temperature, for not less than 15 minutes and not more than 60 minutes total elapsed time for testing of any one test piece. Alternatively, heat the test pieces in an oven adjacent to the testing machine and then remove them one at a time, and test within 15 seconds of removal. The technique for heating and testing the test pieces shall be agreed upon by the purchaser and the supplier.

4.5.2 *Expression of Results*

4.5.2.1 Record the cord adhesion value in newtons and calculate the median value of the test results.

4.5.2.2 Describe the appearance of the cord indicating whether the rubber has remained adhered to it or not.

5 METHOD B : T-TEST

5.1 Principle

5.1.1 Assessment of adhesion between a rubber and textile cord is made by measuring the force required to pull a single cord from a block of cured rubber. The test piece resembles the letter T, from which the test derives its name.

5.2 Apparatus

5.2.1 *Suitable Mould*

as shown in Fig. 6.

5.2.2 *Testing Machine*

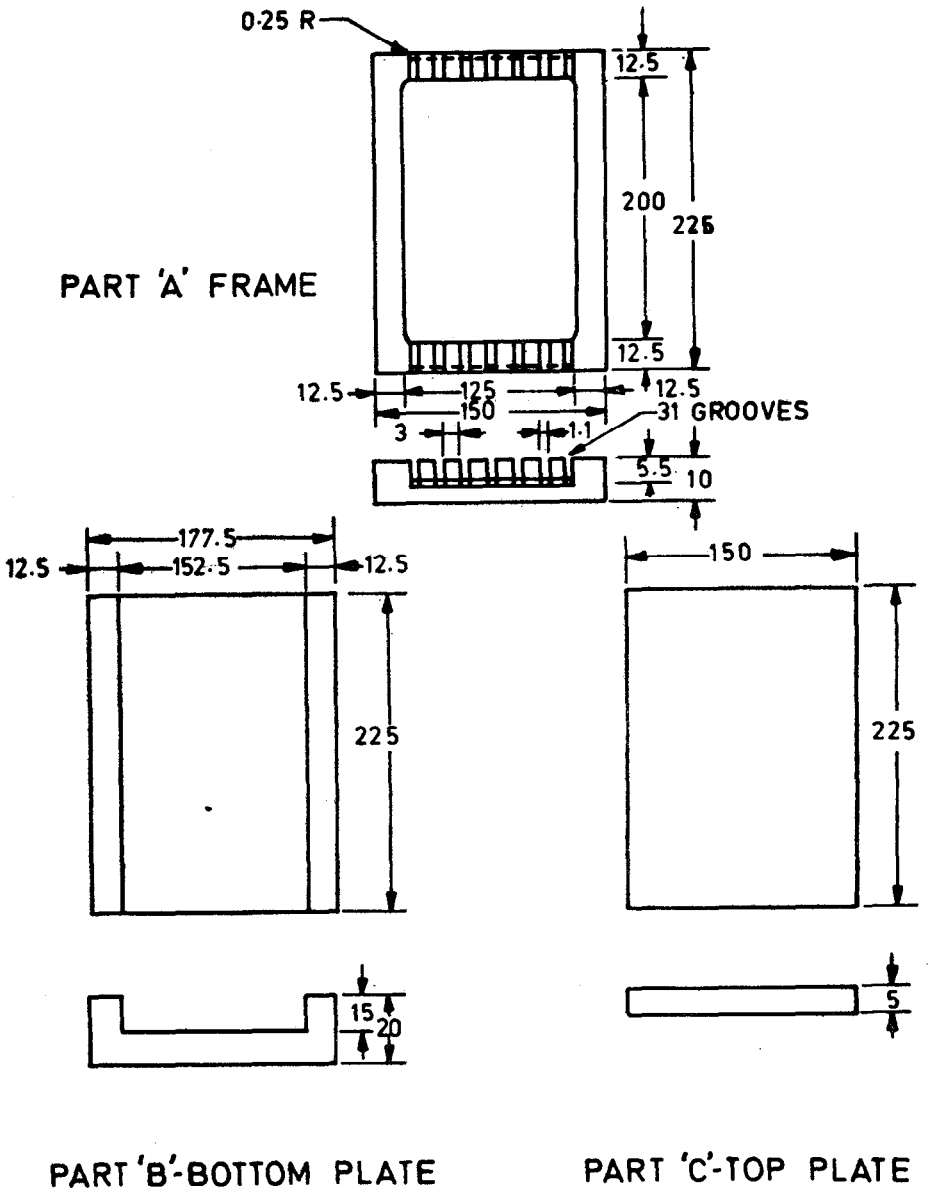
as described in **4.2.3.**

5.2.3 *Test Piece Grip*

The design of the test piece grip shall be as shown in Fig. 5.

5.3 Materials

same as in **4.3.**



All dimensions in millimetres.

FIG. 6 ADHESION TEST SPECIMEN MOULD

5.4 Test Piece

5.4.1 *Dimensions*

The standard test piece shall be a length of cord embedded in rubber strips nominally 10 mm wide and 10 mm thick.

5.4.2 *Preparation of Test Specimens*

5.4.2.1 Fasten one end of the dipped cord sample to one end of the metal frame and wind the cord back and forth across the cord slots under a tensioning force of 0·49 ± 0·01 N. Wear gloves during this operation to prevent contamination of the cord. Fasten the dip cord to the diagonally opposite end of the metal plate and cut off excess length of the dipped cord sample.

5.4.2.2 Cut several slabs of unvulcanized rubber, each 200 mm × 125 mm × 1·7 mm, and two sheets of cotton backing fabric, each 175 mm × 125 mm. Remove polyethylene backing film from one of the unvulcanized rubber slabs and place one piece of cotton backing fabric on it, leaving a 25 mm strip uncovered at one edge. Repeat the procedure with the second slab of the unvulcanized rubber.

5.4.2.3 Place the assembled slabs with a cotton backing fabric adjacent to the cord wound on the frame with the uncovered 25 mm strips touching each other. Place additional unvulcanized rubber stock (after removing the backing polythene) on both faces or the sandwich to fill the mould properly.

5.4.2.4 Assemble the top, frame and bottom plates taking care to see that there is no looseness between them. Place the loaded mould between the platens of the vulcanizing press, the platens having previously been brought to the correct temperature. Adjust the pressure to a minimum of 3·5 MPa with reference to the mould surface. After curing for specified time at the specified temperature, remove the mould immediately and cool at room temperature.

5.4.2.5 With the help of a precision cutter, cut through the rubber a line perpendicular to the inner edge of the cotton backing fabrics without damaging the cords. Repeat the operation from the other side. Cut the block of rubber left with the cords attached with it, into a 10 mm strip. The test specimen should have clean edges.

5.4.3 *Time Interval Between Vulcanization and Testing*

same as in **4.4.4**.

5.5 Procedure

5.5.1 Set the tensile testing machine to rate of traverse of 300 ± 10 mm/minute.

5.5.2 Secure the test piece grip in one jaw of the tensile testing machine. Insert the cord layer through slit 2·60 mm wide in the base of the strip and hold in the other jaw. Take care to ensure axial alignment.

5.5.3 Start the machine and let the cord be pulled out of the rubber stock. Record to the nearest 1·0 N, the maximum force required to separate the cord from the rubber.

5.5.4 Test at least 8 specimens.

5.5.5 *Expression of Results*

5.5.5.1 Record the cord adhesion value, in newtons, and calculate the median value of the results.

5.5.5.2 Describe the appearance of the cord indicating whether the rubber has remained adhered to it or not.

6 METHOD C : U-TEST

6.1 Principle

Assessment of adhesion between rubber and the textile cord is made by measuring the force required to pull a single cord from a block of cured rubber. In the U-test, the ends of the cord are embedded in the same rubber strip with the cord forming the 'U' from which the test derives its name.

6.2 Apparatus

6.2.1 *Suitable Mould*

The design of the mould shall be as shown in Fig. 7. The dimensions of the test specimens are controlled by the specifications and tolerances of the mould. The dimensions *A* and *B* shown in Fig. 7 are dependent on cord diameter as given below:

Cord Diameter mm	*A* mm	*B* mm
Up to 0·81	1·57	0·79
Above 0·81	2·80	1·22

6.2.2 *Testing Machine*

same as in **4.2.3**.

6.2.3 *Heating Chamber*

designed to hold the insert and specimen with a variable temperature control from 10 to 150°C, as shown in Fig. 8A.

6.2.4 *Test Piece Grips*

designed to grip the specimen loop as shown in Fig. 8B.

6.3 Materials

same as in **4.3**.

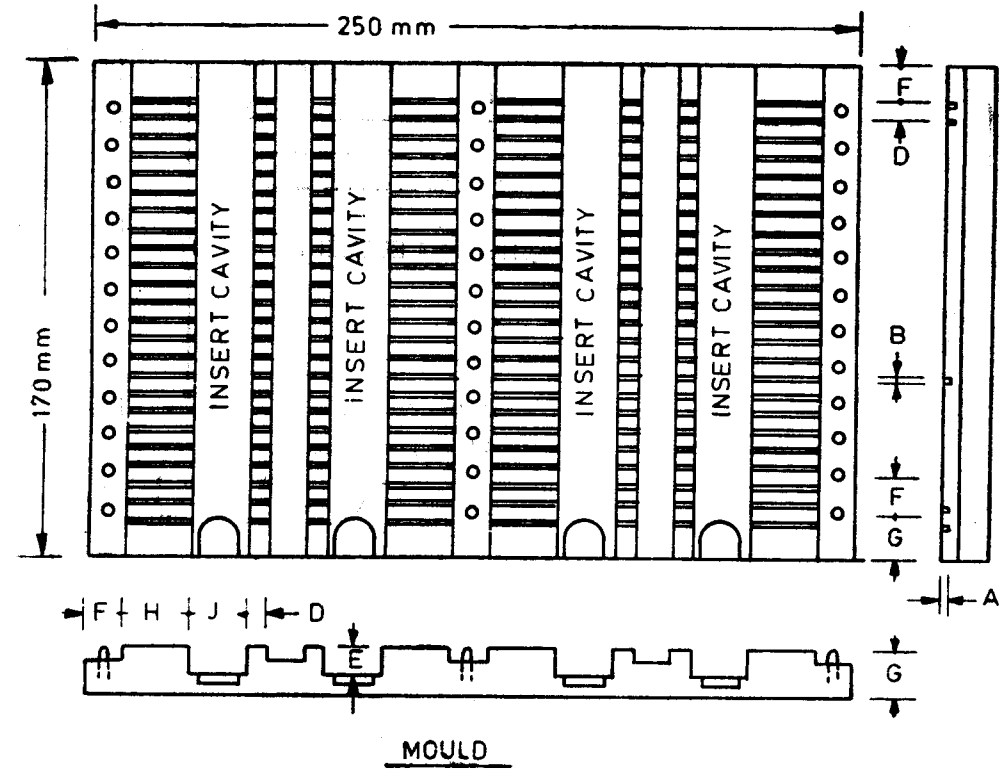
6.4 Preparation of Test Specimens

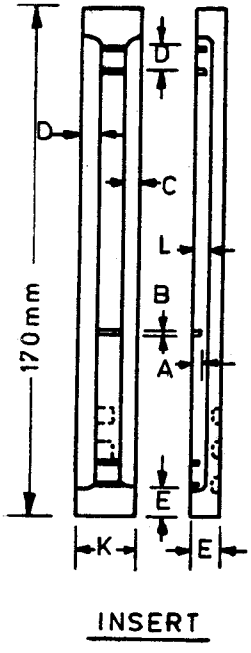
6.4.1 Cut the rubber compound with scissors or cutter into strips 6·4 mm wide and 150 mm long, with the polyethylene film attached.

6.4.2 Place inserts in the moulds with a narrow section facing pins and place a strip of rubber compound, polyethylene film side up, in the bottom of the mould insert. Loop cord samples on outer pin thread continuously in mould grooves around the pins for 6 continuous loops. Similarly, loop the second cord sample to fill the mould. Then place adhesion strip on top of cords in the mould insert.

6.4.3 Fill the balance of the moulds as given in **6.4.1**. Identify samples and place a piece of cotton backing fabric over the entire mould.

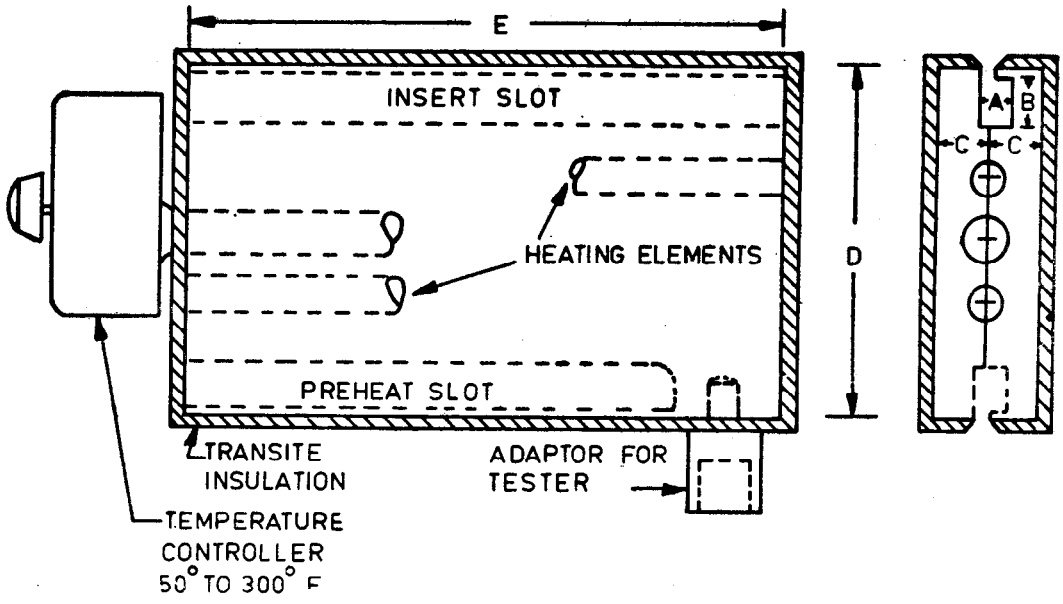
6.4.4 Place the loaded mould between the platens of the vulcanizing press, the platens having previously been brought to the correct temperature. Adjust the pressure to a minimum of 3·5 MPa with reference to the mould surface. After vulcanizing for specified time, immediately remove the test piece from the mould and cool at room temperature. Trim off the overflowing material with sharp knife ware.





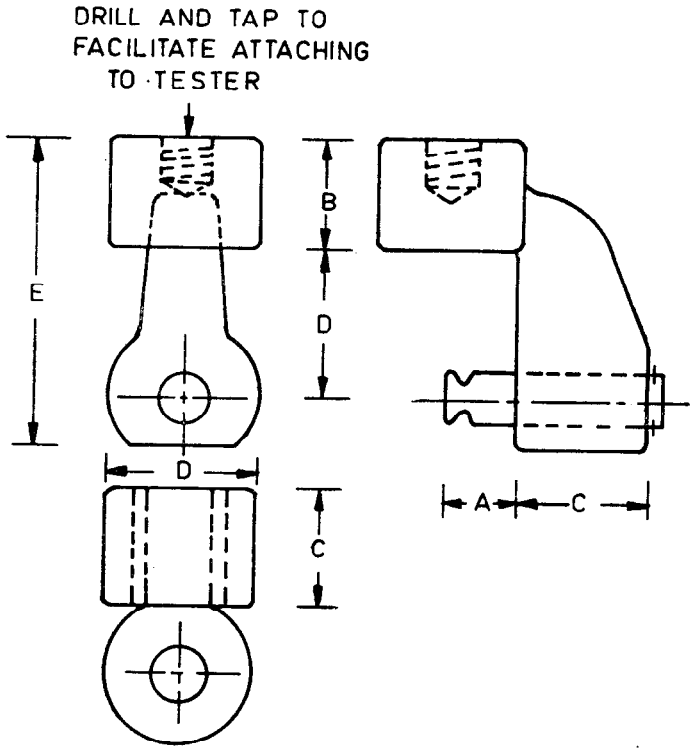
Dimension	mm
A	
B	
C	4·8
D	6·4
E	9·5
F	12·7
G	15·9
H	22·2
J	19·050-19·063
K	19·012-18·999
L	2·74-2·69

FIG. 7 MOULD AND INSERT FOR U-TEST



Dimension	mm
A	9·6
B	19·0
C	15·9
D	115·0
E	200·0

FIG. 8A HEATING FIXTURE AND HOLDER FOR U-TEST



Dimension	mm
A	12·7
B	19·0
C	20·6
D	25·4
E	50·8

FIG. 8B TEST PIECE GRIPS FOR U-TEST

6.5 Time Interval Between Vulcanization and Testing

same as in **4.4.4**.

6.6 Procedure

6.6.1 Set the machine at a rate of traverse of 100 ± 10 mm/minute. Remove the lower jaw and put 'U' tester heater insert such that the groove in the insert is in alignment with the hole in the heater. Then remove the top regular jaw from the machine and replace with the hook type jaw. Place the heater on heater insert of lower jaw and insert the pin and heat to 125 ± 1°C.

6.6.2 Place insert with sample into top lot of heater with sample at the back of the tester using insert handle and pre-heat for 3 minutes. Align the insert such that the sample loop is in direct alignment with the top hook.

NOTE — Another sample can be pre-heated in lower slot heater, making sure that it pre-heats at least for 3 minutes.

6.6.3 As soon as one end of the loop falls, record the maximum force required to separate the cord from the rubber to the nearest 1·0 N. Move the insert to the next loop and continue until all specimens are being tested.

6.6.4 Test at least 8 specimens.

6.6.5 *Expression of Results*

6.6.5.1 Record the cord adhesion value in newtons and calculate the median value of the results.

6.6.5.2 Describe the appearance of the cord indicating whether the rubber has remained adhered to it or not.

7 METHOD D : STRIP ADHESION TEST

7.1 Principle

A known quality of rubber compound is vulcanized with tyre cords in such a way that a two-ply strip is prepared which can then be peeled apart in a tensile testing machine and then the force needed to peel the strips apart is measured.

7.2 Apparatus

7.2.1 *Suitable Mould*

The mould shown in Fig. 6 can be used with suitable spaces to adjust the specimen thickness. Alternatively, rubber covered cord specimens may be prepared in building drums of suitable dimensions and cord spacing.

7.2.2 *Testing Machine*

same as described in **4.2.3**.

7.3 Materials

same as in **4.3**.

7.4 Preparation of Test Specimens

7.4.1 *Dimensions*

same as in **5.4.1**.

7.4.2 Cut several slabs of unvulcanized rubber each 200 mm × 125 mm × 1·0 mm and strips of cotton backing fabrics 50 mm × 125 mm and 200 mm × 125 mm.

7.4.3 Place one slab on each face of the cord wound on the frame, and apply a pressing roller across the face in reverse direction to that used in winding. Ensure that the air is not entrapped. Cut the assembly from the frame and lay down flat on a clean surface. Clear off excess cord around the grooves.

7.4.4 Repeat procedure given in **7.4.2** and **7.4.3** to obtain a second rubbered strip. Alternatively, rubber covered cord specimens may be prepared in building drums of suitable dimensions and cord spacing.

7.4.5 Put a 50 mm × 125 mm strip of cotton backing fabric along the edge of the fabric running at right angles to the warp of one of the rubbered strips.

7.4.6 Place a second rubbered strip on top of the first in such a manner that the cords in both layers are exactly parallel and that one edge of the sandwich is separated by the cotton backing fabrics to a depth of 50 mm.

7.4.7 Place additional rubber compound on both faces of sandwich to obtain a total thickness of 6 mm, *Max*. Finally, place two strips of cotton backing fabric 200 mm × 125 mm on both the top and the bottom faces of the sandwich. Starting from the bottom to the top, the assembly is as follows:

Bottom

Cotton backing fabric
Rubber compound
Strips to be tested
Rubber compound, 1 mm thick
Strip to be tested
Rubber compound

Top

Cotton backing fabric

7.4.8 Place the sandwich inside the metal frame and assemble the frame, bottom and top plates and spaces, taking care to see that there is no looseness between them. Place the loaded mould between the platens of a vulcanizing press and proceed as in **5.4.2.4**.

7.4.9 With the help of a precision cutter, cut off approximately 12 mm width strip from both sides and discard.

7.4.10 Cut four test pieces 25 ± 0·5 mm wide and at least 150 mm long, parallel to the warp and separate the bifurcated end by cutting off the tip end of the rubber and removing the cotton backing fabric.

7.5 Number of Test Pieces

Duplicate test pieces should be used.

7.6 Time Interval Between Vulcanization and Testing

same as in **4.4.1**.

7.7 Procedure

Set the tensile testing machine to a rate of traverse of 300 mm/minute. Fix the test piece in the grip of the testing machine so that the separation point is positioned in the middle of the two strips (*see* Fig. 8C and 9), and adjust so that the tension is distributed uniformly and so that no twisting of the test piece occurs during the test. It is important to ensure that the axis of the strips of test piece are held in the grips, that is, in the same plane (*see* Fig. 9). Zero the force-measuring system and start the machine. Continue the ply separation and record the force over a length of separation of at least 100 mm, the recorded chart having sufficiently large scale to allow easy interpretation of results.

7.8 Expression of Results

7.8.1 The adhesion strength of the test piece should be calculated as mean of the lowest 50 percent of peak values taken from the central 50 percent of the stripping trace, as described in the following note. The adhesion strength should be expressed in kilo newtons per metre width.

NOTE — A typical trace for adhesion is reproduced in Fig. 10. For the calculation of adhesion strength, a 'peak' is defined as a part of the trace where the force measured either maintains a steady value for a significant time or shows the rise to a maximum followed by a fall. Such peaks are indicated by arrows on the reproduction.

In the example, 'Peaks' are present at the following forces, reading from left to right in the central 50 percent of the trace:

43·6	41·0	41·3	43·0	42·5	37·8	37·5
36·7	43·0	42·8	43·4	43·0	40·7	43·3
41·1	42·4	43·3	43·2	41·2	42·6	42·0
41·7	40·3	40·3	39·9	43·2	43·5	42·1
42·5	42·3	42·3	42·2	42·1	41·1 units	

The lowest 50 percent of these 'Peaks' are:

41·0	41·3	37·8	37·5	36·7	40·7	41·1
41·2	42·0	41·7	40·3	40 3	39·9	42·1
41·1	42·1	42·2 units				

The mean of these 17 readings is 40·47 units which is quoted as the adhesion strength.

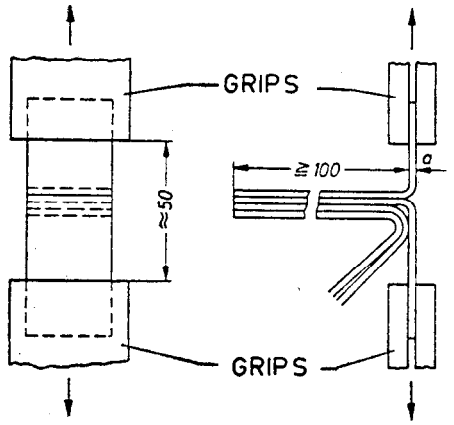


FIG. 8C INSERTION OF STRIP SPECIMENS

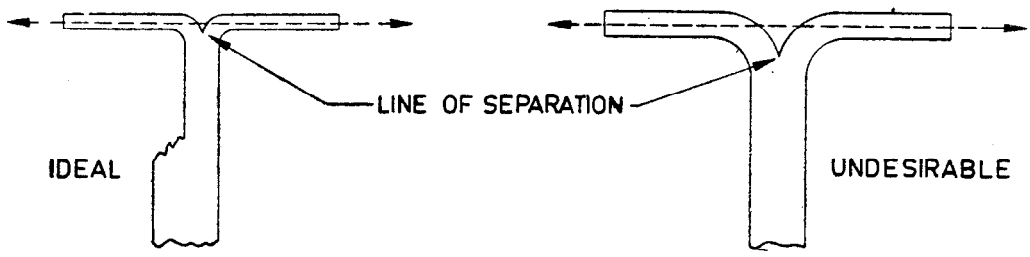


FIG. 9 POSITION OF LINE OF PREPARATION OF PLIES

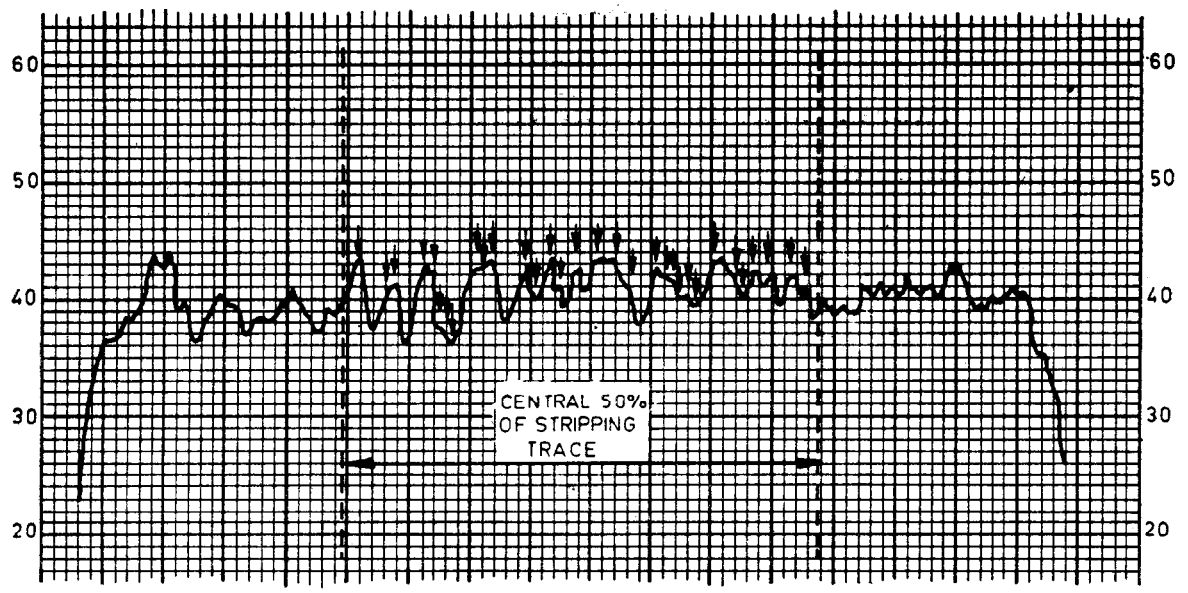


FIG. 10 TYPICAL TRACE FOR ADHESION TEST

7.8.2 The adhesion strength reported should be the average results determined for duplicate test pieces.

7.8.3 The type of failure should be described using the following terminology:

a) 'R' indicates the failure in the rubber layer,

b) 'RA' indicates that the failure is between the rubber layer and the adhesive,

c) 'AT' indicates that the failure is between the adhesive and the fabric,

d) 'RB' indicates that the failure is in the rubber and between two fabric plies, and

e) 'T' indicates the failure in the fabric.

8 TEST REPORT

8.1 The test report shall include the following particulars:

a) Reference to the test method;

b) Complete identification of the cord;

c) Details of rubber compounds, cure time and temperature;

d) Method of preparing test pieces;

e) Conditioning temperature and relative humidity;

f) Test temperature;

g) Any non-standardized procedure(s);

h) Number of test pieces tested;

j) All individual test results and arithmetic mean or median of the results;

k) Type of grip used;

m) Type of fabric; and

n) Date of test.

ANNEX A

(*Clause* 4.2.1.1)

PREPARATION OF SILICON-RUBBER-FACED BARS

A-1 SILICON COMPOUND

A-1.1 The compound used shall be a self-bonding grade of silicon rubber of hardness about 60 IRHD.

A-1.2 Depending on the mould plate size available, press out between sheets of polyester a 50 to 60 g piece of the compound using the flat mould plates to obtain as even a thickness (1·5 mm) as possible.

NOTE — The pressing is best done in a hydraulic press at very low pressure (less than 175 kPa). A hand-pump press is preferable. The platens may be heated to 50 to 70°C, if required.

A-1.3 After pressing for 2 to 3 minutes, examine the silicon rubber to see if the required thickness has been reached. If it is not possible to attain a thickness of 1·5 mm, a thickness up to 2 mm is permissible.

A-1.4 Remove the sheet of silicon rubber and store it on a flat cool surface, still protected by the polyester film.

A-2 BAR PREPARATION

A-2.1 Remove as much old silicon rubber as possible by scraping, mechanical wire brushing of the bars, or similar means.

A-2.2 Degrease the bars in vapour degreasing bath using trichloroethylene or perchloroethylene for 30 to 60 minutes but it is advisable to protect the non-bonding surfaces to prevent unnecessary roughening.

A-2.3 Abrade the bars on the bonding surfaces using only fine emery cloth. Light shot or vapour blasting may be used but it is advisable to protect the non-bonding surfaces to prevent unnecessary roughening.

A-2.4 Finally clean the bars by wiping liberally with a clean cloth soaked in a petroleum solvent, the solvent being allowed to evaporate. Apply the silicon strip as soon as possible after cleaning.

A-3 BONDING PROCEDURE

A-3.1 Cut strips from the polyester film protected silicon rubber to fit the bonding areas on the bars. If the silicon rubber is unavoidably thick, the width of the strips (normally about 10 mm) may be reduced by 1 to 2 mm to prevent excessive spew.

A-3.2 Peel the polyester film from one face of the strip, place the exposed face on the freshly cleaned bonding area and manually, lightly press into contact. Avoid contact with the exposed silicon surface and the prepared bar surface to prevent contamination and hence poor bonding.

A-3.3 Prepare two bars at a time. These should be used as a pair and preferably marked for easy identification.

A-3.4 Place the bars in suitable mould, side by side, with the silicon faces uppermost. The top layers of polyester film may now be removed if required, but to facilitate easy demoulding, a piece of polyester film, sufficient to cover the mould cavity, should be inserted. Alternatively, the mould lid should be sprayed with a PTFE aerosol mould lubricant.

A-3.5 With the lid located by the matching holes and pegs of the bars, place the moulds in a press while the platens are warming up, and use a low pressure to spread the silicon. When the full curing temperature of 160°C is reached, apply the higher possible safe pressure and vulcanize for 15 minutes.

A-3.6 Cool the bars, preferably in the moulds in the press still under pressure. If this is not possible allow the complete mould to cool out of the press as at this stage the silicon is still weak and prone to damage when hot.

A-3.7 When cool, carefully remove the faced bars from the mould. This may be facilitated by removing one of the screwed mould and stops allowing a thin lever to insert under the bars.

A-3.8 Excess silicon spew, etc, may then be trimmed out or this may be deferred until after the oven cure.

A-3.9 When all the bars to be refaced have been press cured, store them for 18 to 24 hours at 27 ± 2°C temperature. Remove excess spew, etc, if this was not carried out at the previous stage.

NOTES

1 When in use, the silicon rubber may protrude beyond the edge of the bar. If a trial pull-through test piece is moulded, the amount of excess silicon may be measured by examining the test piece cross section which will be of H-section if the silicon protrudes. The edge of the silicon should be trimmed back from the edge of each bar by slightly less than the depth of the indentation caused in the pull through test piece.

2 With normal usage, a minimum of 500 test moulding can be expected before the bars need to be refaced.

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